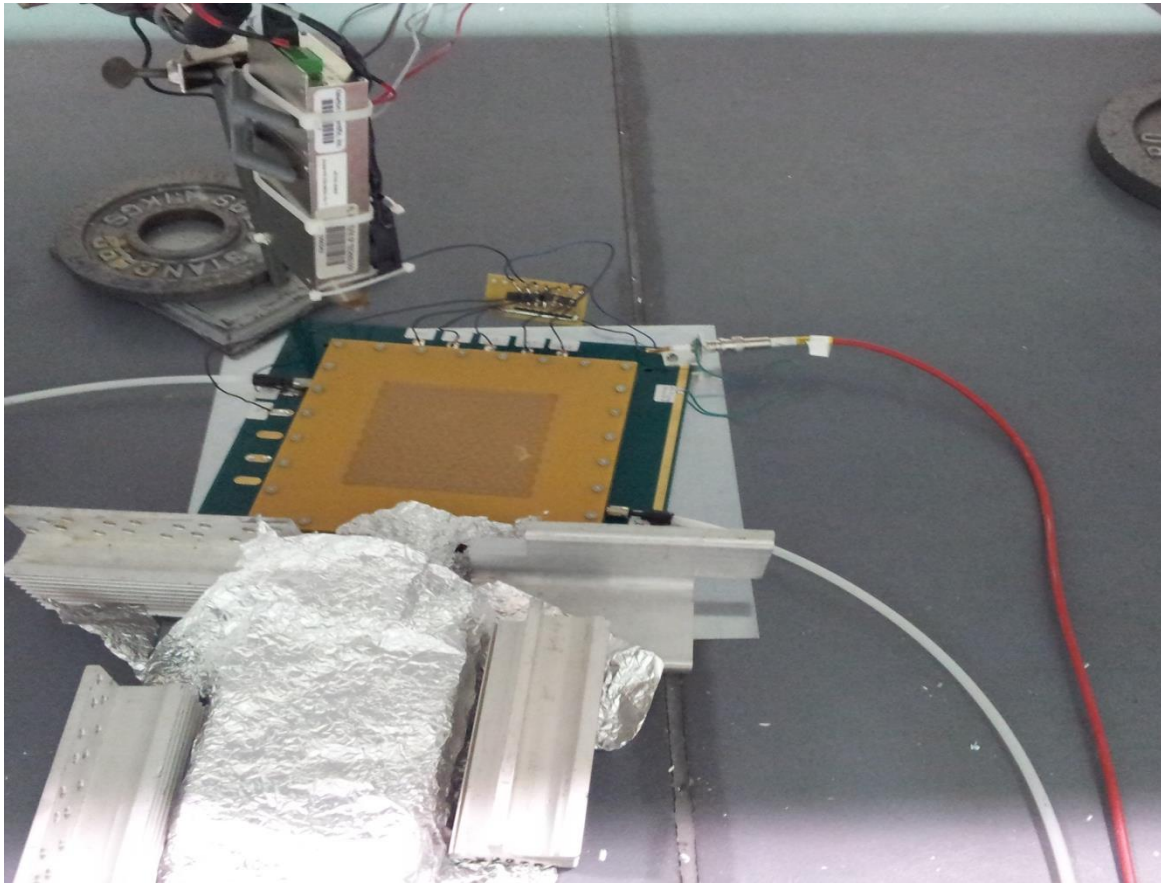


Gain measurement of a 10 by 10 cm² GEM with 30 zigzag r/o strips

Aiwu Zhang

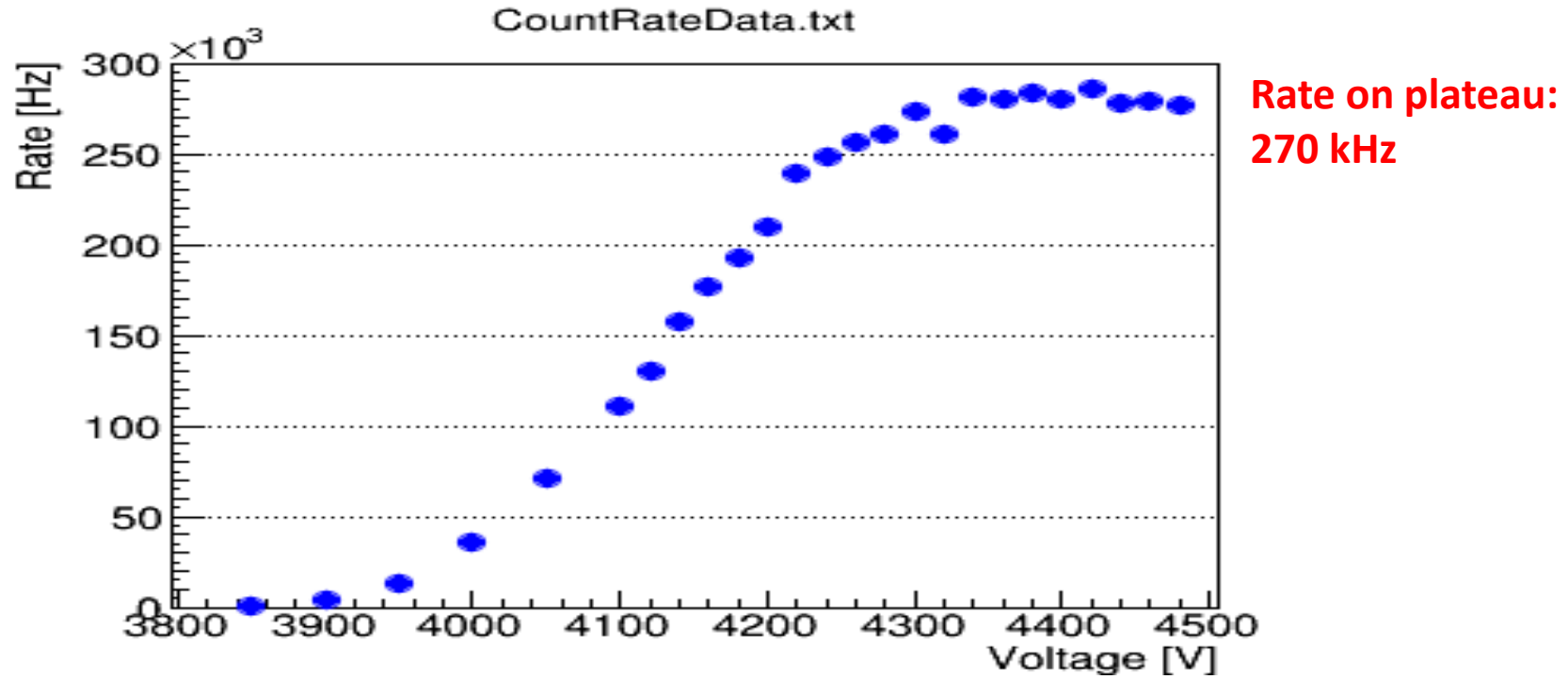
2015-04-27

Setup



- This is a 10 cm by 10 cm GEM with zigzag r/o strips (30 strips);
- Noise problem: crazy noise (with pre-amp. and linear amp.) if read out from bottom of 3rd GEM foil or read out all the zigzag strips;
- Noise is durable when reading out only 4 strips.

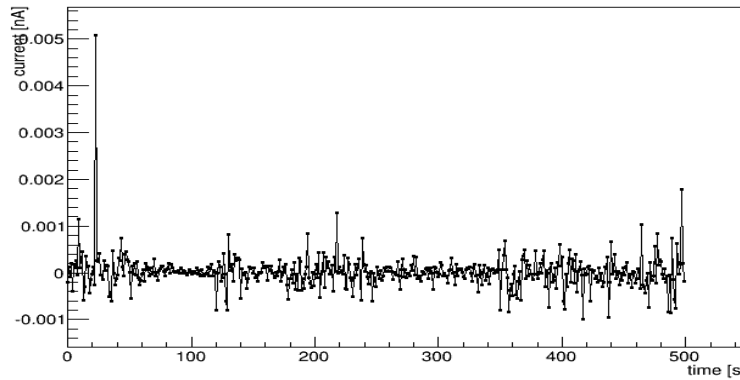
First counting rate measurement



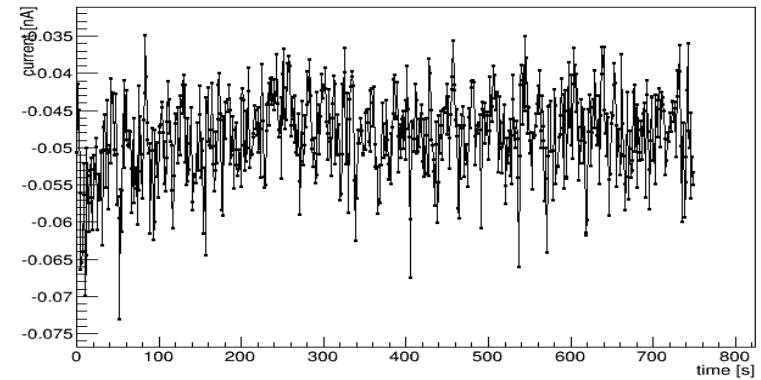
- Measurement for the case of using 4 strips;
- Linear amp factor: $50 \times 1.5 = 75$, to adjust for a proper threshold that can be set in the discriminator (threshold: 50mV);
- Xray set: 10kV/5uA, no collimator; ~20cm above chamber;
- Background counts are subtracted (they don't vary a lot when HV increases).

First current measurement with pA meter

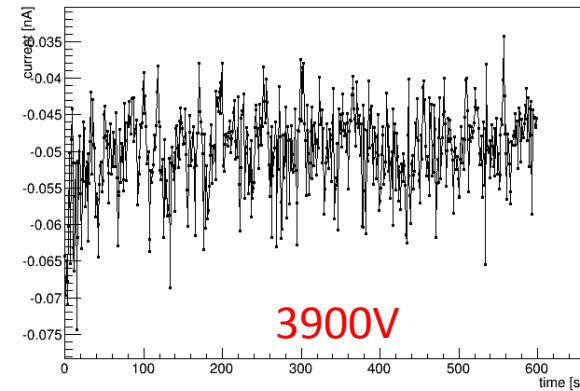
X ray OFF ;3850 V



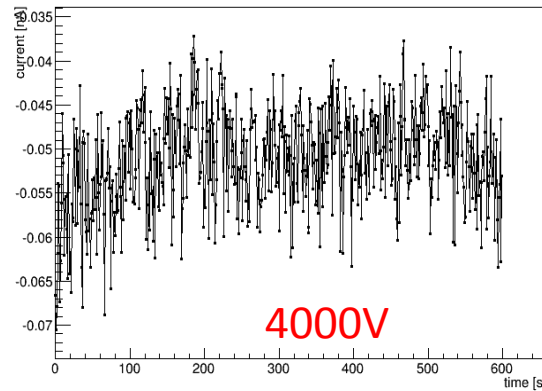
X ray on at 10kV/5uA; 3850 V



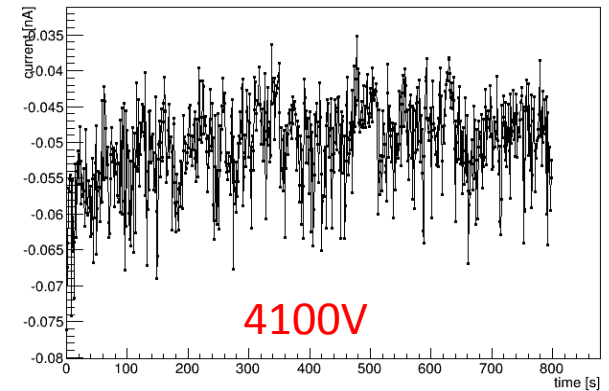
X ray On at 3900V



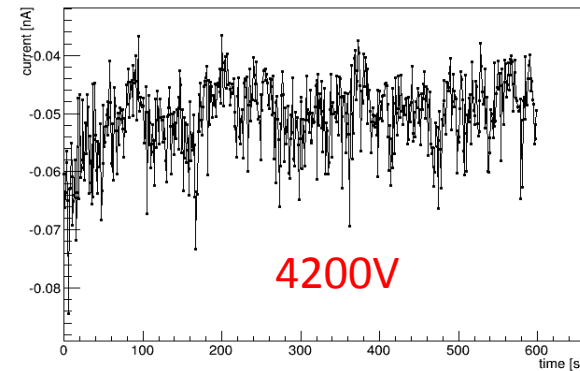
X ray On at 4000V



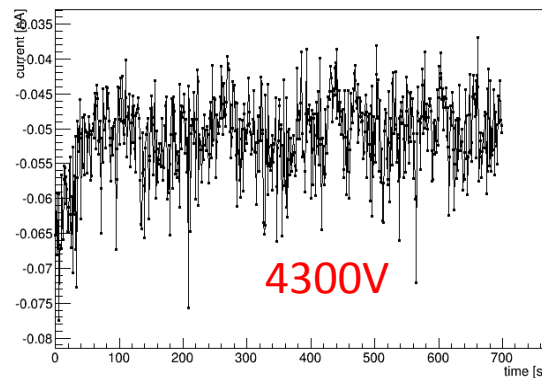
X ray On at 4100V



X ray On at 4200V

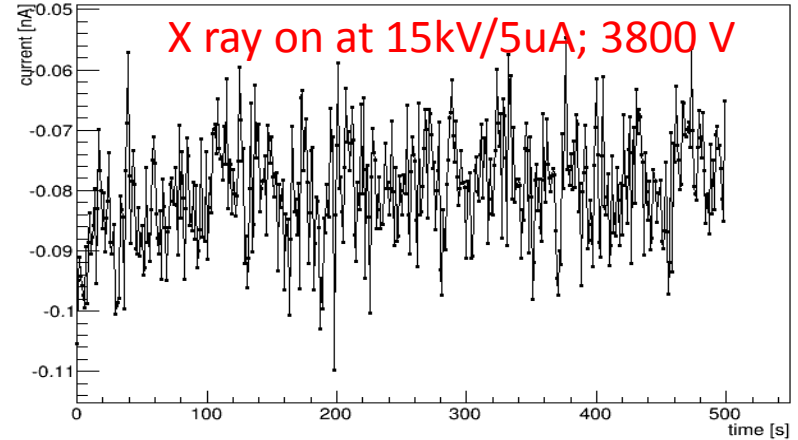
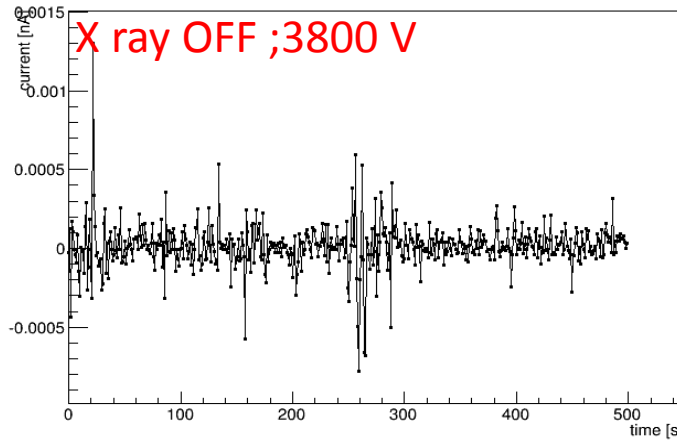


X ray On at 4300V

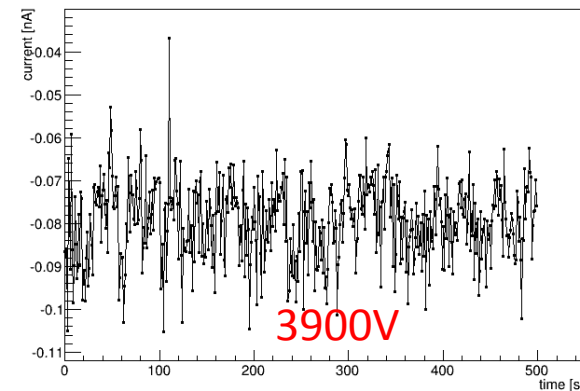


Xray set 10kV/5uA, read out 4 strips, measured current is always around -0.05 nA.

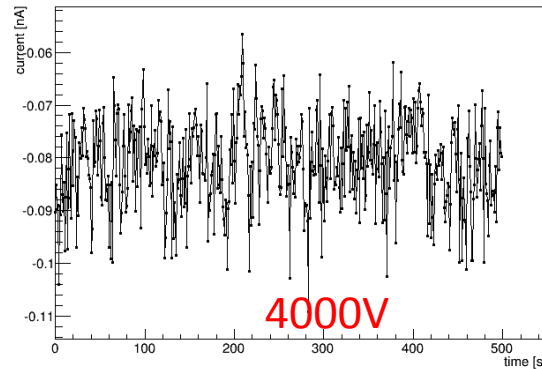
First current measurement with pA meter



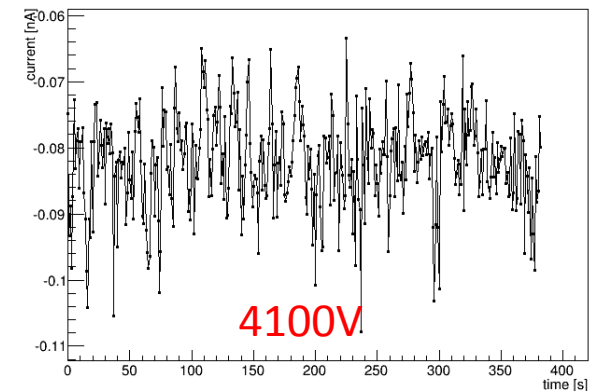
X ray On at 3900V



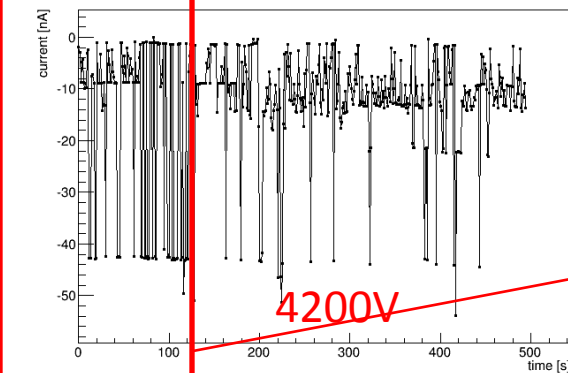
X ray On at 4000V



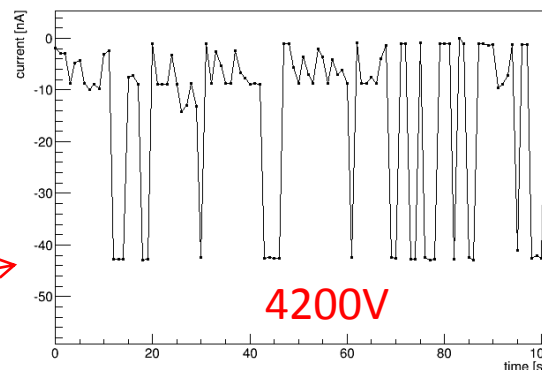
X ray On at 4100V



X ray On at 4200V

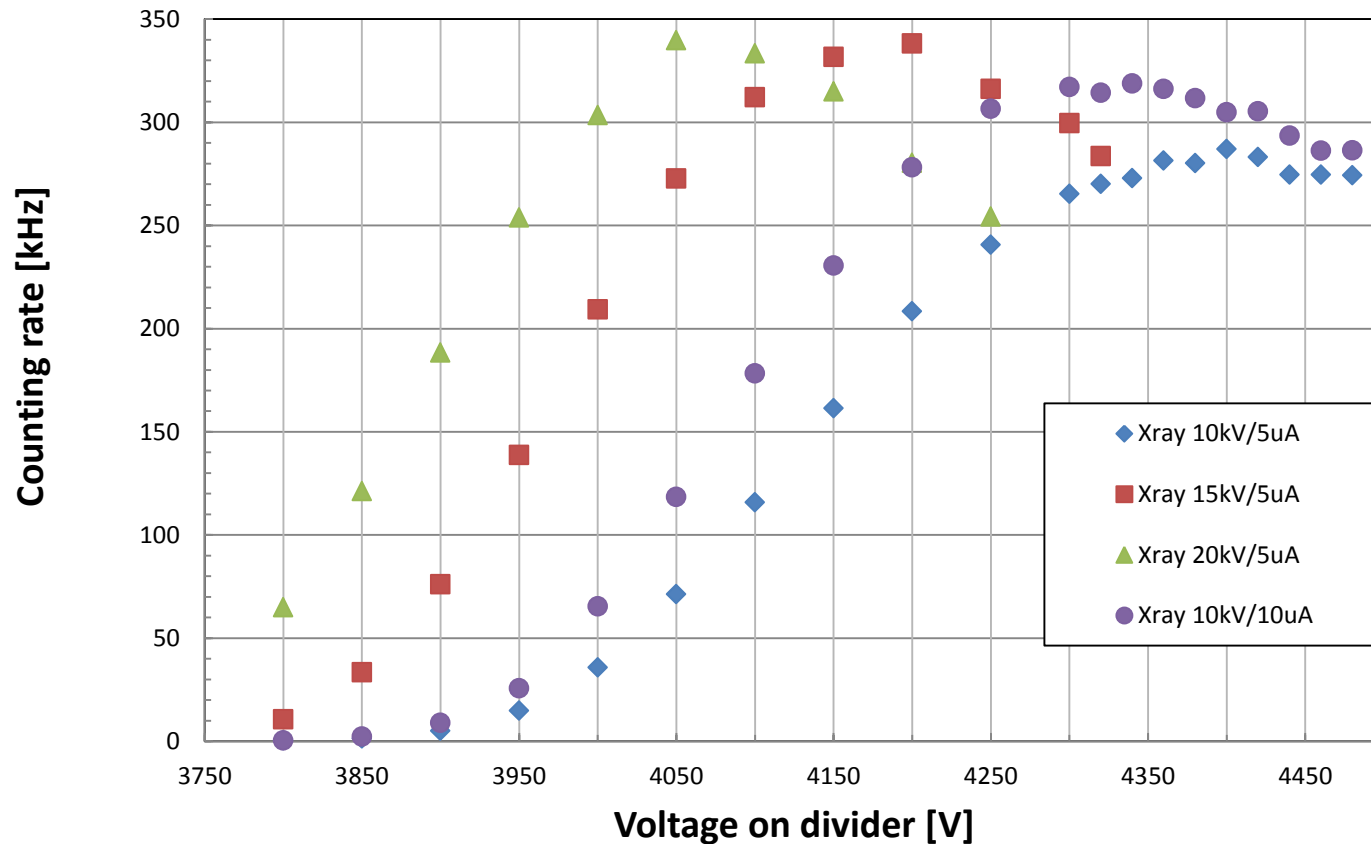


X ray On at 4200V



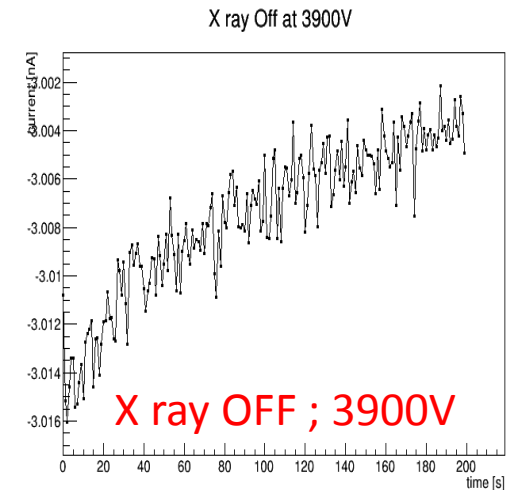
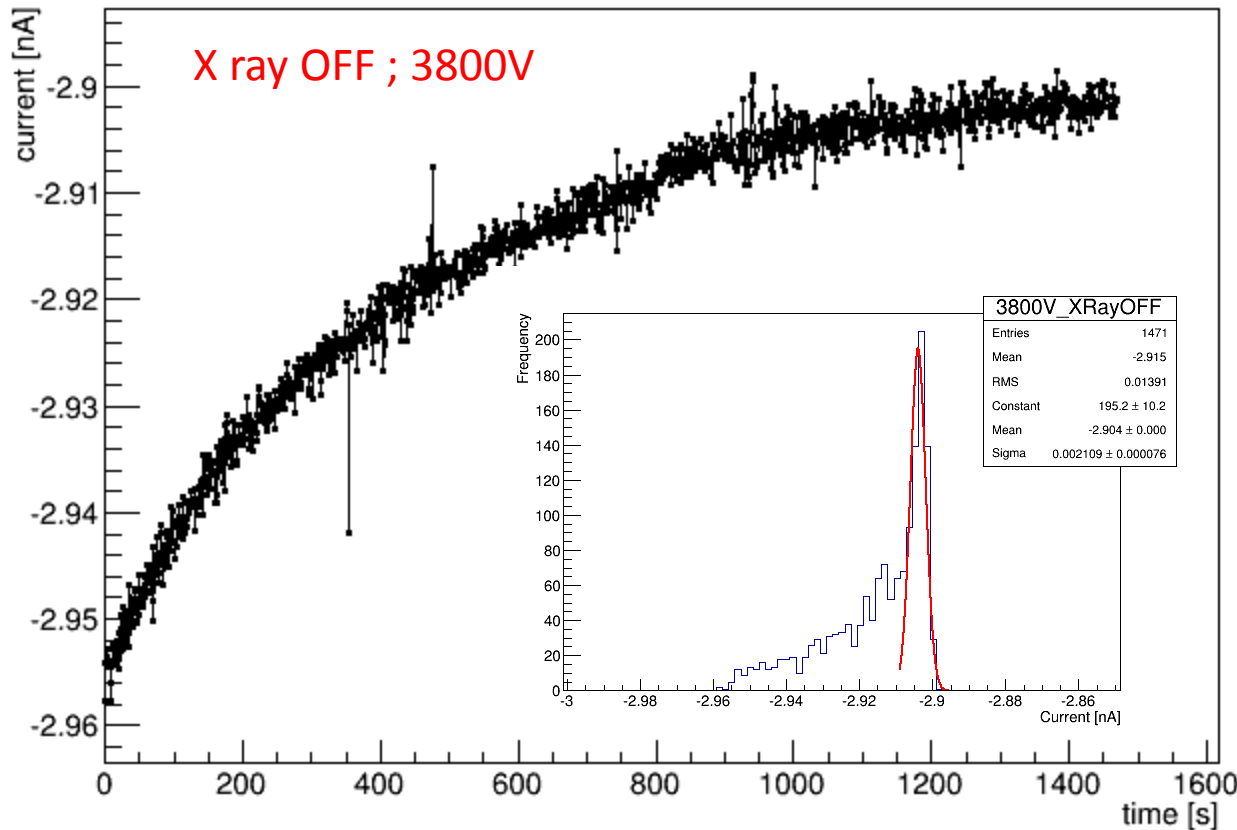
- Xray set 15kV/5uA, read out 4 strips, measured current is around -0.08 nA.
- Till 4200V, current behaves abnormal, it can go to 43 nA.

Second counting rate measurement



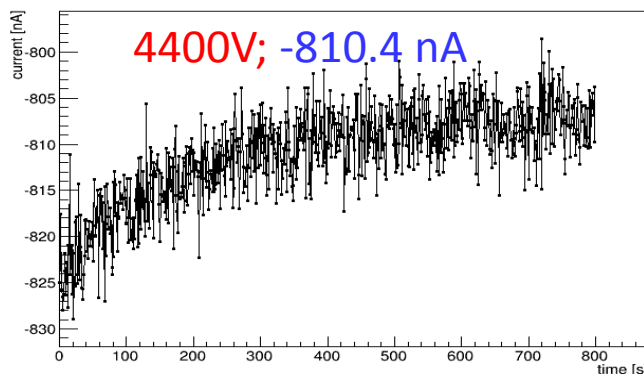
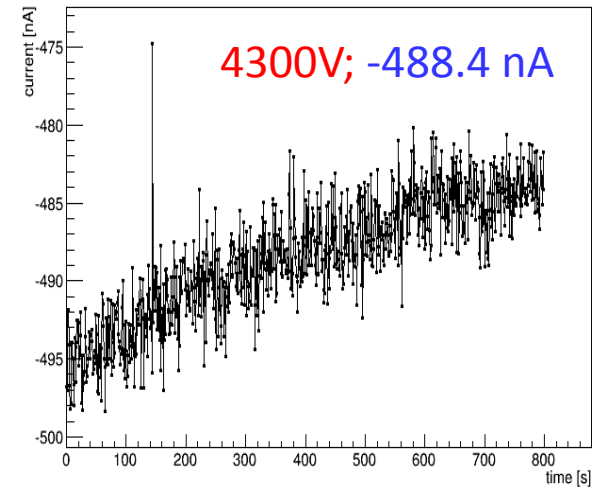
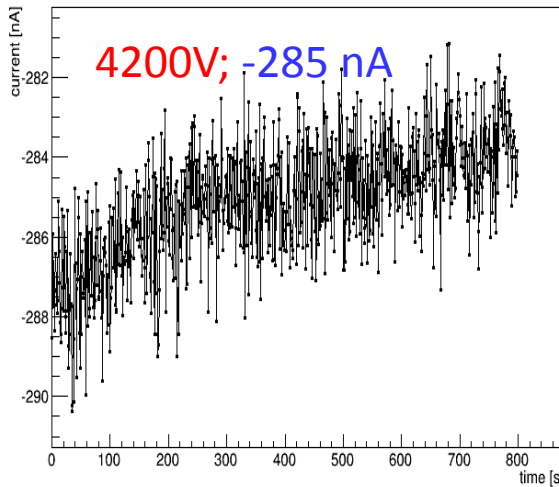
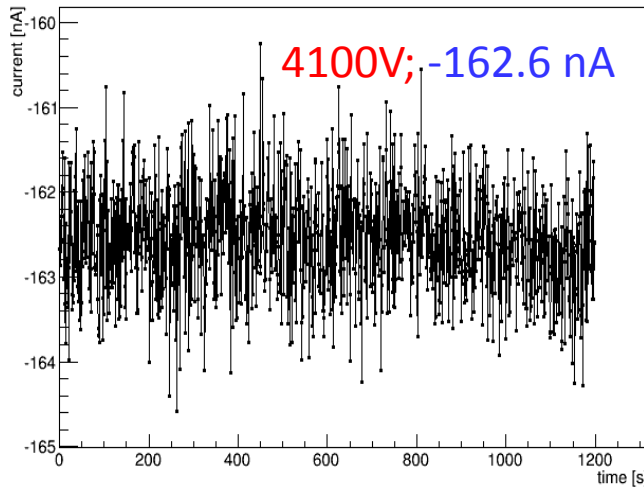
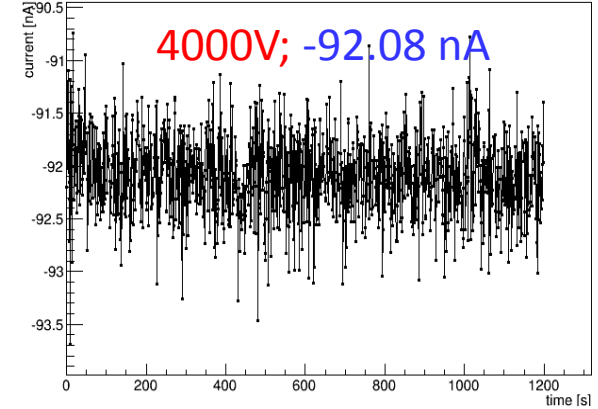
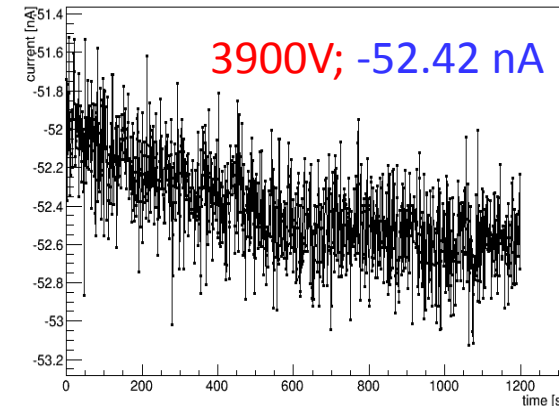
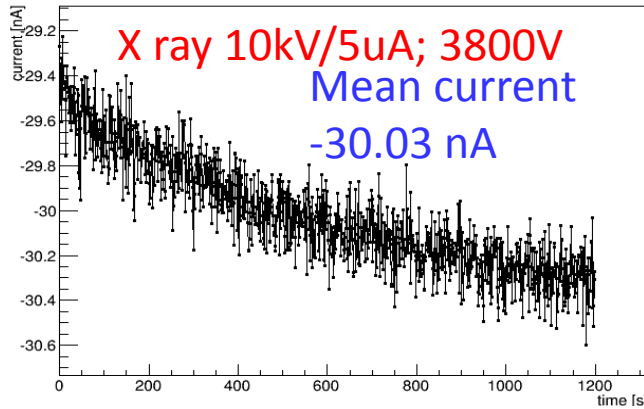
- Different counting rates are measured with different Xray settings on the 4 zigzag strips;
- At Xray 10kV/5uA, rate is again around 270kHz.

Current measurement with pA meter – read out all strips



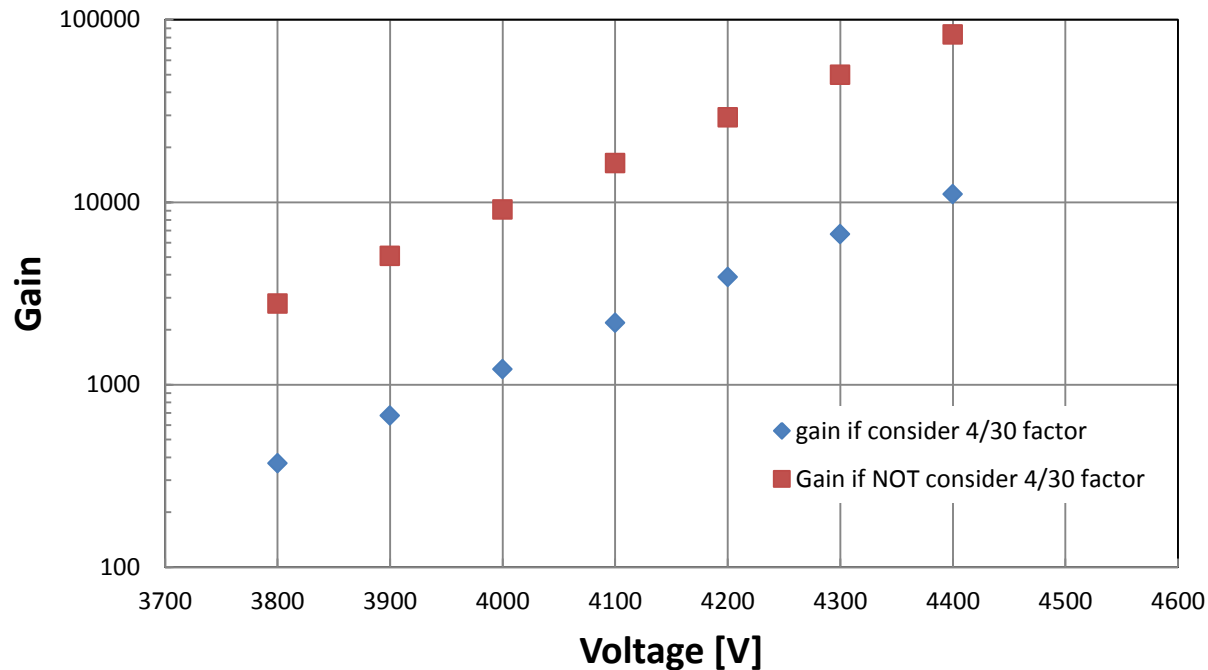
- When X ray is off; **noise current is slightly increasing all the time**, in a small range **around -2.9nA**
- Increase voltage does not affect noise current significantly;
- Noise current is taken as -2.9 nA in the gain calculation.

Current measurement with pA meter – read out all strips



- Good current can be measured if all the 30 strips on the r/o board are read out;
- Currents at some HV points are not stable but with a small variation;
- X ray is set at 10kV/5uA.

Gain curve



- Gain is calculated as: $G = I / (R \cdot n_T \cdot e)$;
- Since counting rate is measured with 4 r/o strips, but current is measured with all (30) strips on the r/o board, the gain is calculated with a **4/30** factor in consideration. Is this correct?
- The **gain reaches 10k at 4400 V**. (note that in counting rate measurement the HV goes to 4480 V without discharging at Xray-10kV-5uA.)

summary

- When measuring current, it is better to read out all strips. With a few strips, the current is too small to be measureable; this explains why we got very small gains when testing the large 1-m GEM detector.
- For this tested 10 by 10 cm² GEM with zigzag r/o strips, nice counting rate and good gain are achieved.